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Environmental Protection
Agency

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July 15, 1992

Steven H. Wisness
Tri-Party Agreement Manager
U.S. Department of Energy
P.O. Box 550, A5-15
Richland, WA 99352

Subject: TECHNICAL REVIEW OF COLUMBIA RIVER IMPACT EVALUATION
PLAN DOE/RL-92-28 DRAFT A

Dear Mr. Wisness:

Tri-Party Agreement (TPA) milestone M-30-02 calls for the U.S. Department of Energy (DOE) to "Submit a plan (primary document) to EPA and Ecology to determine cumulative health and environmental impacts to the Columbia River, incorporating results obtained under M-30-01". The U.S. Environmental Protection Agency (EPA) and our contractors have reviewed this report. Enclosed are our comments.

If you have any questions or comments, please direct them to me at (509) 376-9884.

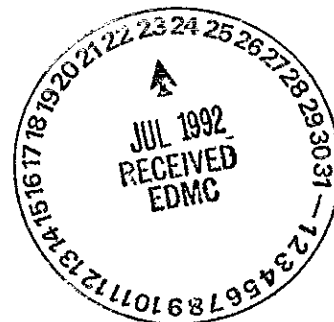
Sincerely,

Laurence E. Gadbois

Laurence E. Gadbois
Environmental Scientist

Enclosure: (1) Comments on DOE/RL-92-28 Draft A

Copy: Eric Goller, DOE
Chuck Cline, Ecology
Steve Cross, Ecology
David Jansen, Ecology
Darci Teel, Ecology
Audree DeAngeles, PRC
Ward Staubitz, USGS
Bob Peterson, WHC
→ Tim Veneziano, WHC (Admin Record, 100 Area Operable Units)
Steve Weiss, WHC



GENERAL COMMENTS

This report is a concise presentation of the information needed to evaluate the impacts of 100 Area contaminants on the Columbia River. A comprehensive presentation including existing data may be more appropriate to thoroughly evaluate the approach used for this study. Information that is missing and should be included is listed below.

- The rationale to use only the data from "DOE, 1990(a)" for groundwater plumes is not provided. If other data are available, they should be included. If other data are not available, this should be stated.
- No discussion is provided on the data quality and quantity used for the study.
- The basis for the assumption that the aquifer extraction rate is analogous to the groundwater flow rate is not provided (Section 2.2.1, page 15).
- The data used to identify the groundwater contaminants that exceeded either "the drinking-water standards (40 CFR 141-143, and Chapter 248-54 WAC) or the groundwater standards of the Model Toxics Control Act Cleanup Regulations (MTCACR; Chapter 173-340 WAC)" are not included.
- The basis for selection of contaminant source concentrations is not provided (Table 2.1).
- A summary of past and existing levels of surface water contamination is presented in Figures 2.6 through 2.9 for locations upstream and downstream of the Hanford site (Section 2.2.2). The data presented in these figures may not indicate the river water quality for contaminants of concern that have been identified in groundwater because of dilution effects at the downstream sampling point (River Pump House). Data relating to analytical samples collected upstream and downstream from the site are presented, but data on samples collected along the Hanford Reach should be also be presented and evaluated to assess the impacts of groundwater discharge on river water quality. The distance of sampling locations from the shoreline, sampling and analytical procedures, and quality controls used for the data collection are not discussed, but should be.
- The discussion on the impact to river water quality from spring discharges is too general (Section 2.2.2.2). Data should be included to determine the

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localized zones of potentially contaminated river water resulting from riverbank springs seepage. The localized zones of contaminated river water may affect aquatic biota exposed to the contaminated water.

- The river sediment sampling locations are not shown on a map (Section 2.2.3). The rationale used for sediment sample selection location along the Hanford Reach is not provided. The distance of sampling locations from the shoreline, sampling and analytical procedures, and quality controls used for the data collection are not discussed, but should be. Data on the presence of metals in the sediments are not included.
- The model output data are not included in the plan, but should be.

The human health evaluation presented in Section 4.1 does not comply with the Hanford Site Baseline Risk Assessment Methodology (HSBRAM) (DOE 1991a). Although the text states that this section consists of a "preliminary and qualitative evaluation," the HSBRAM should be used to determine human health threats because EPA was not consulted regarding what constitutes a qualitative human health evaluation. In particular, the human health evaluation should comply with the HSBRAM in the following areas:

- **Determination of land use scenarios.** The plan addresses residential land use for only the city of Richland. However, the 100 Area could become a residential area in the future. The HSBRAM requires consideration of future land uses and associated risks. Land use scenarios for use in the qualitative risk assessment should be determined through discussions among the tri-parties (that is, the Environmental Protection Agency [EPA], U.S. Department of Energy [DOE], and the Washington State Department of Ecology [Ecology]).
- **Exposure assessment.** The exposure assessment is seriously flawed and thus has limited usefulness. The exposed population discussed under the recreational scenario is inappropriately limited to adults. The exposure parameters listed in Table 4-2 are incorrect when compared with exposure parameters outlined in Tables A-4 and A-5 of the HSBRAM. Background concentrations are subtracted from estimated concentrations in the river when determining intake values for carcinogenic compounds; this is not done because the public is concerned about the total incremental cancer risk (that is, background plus site risks), not just the incremental cancer risk posed by site activities. The public is exposed to the total contaminant concentrations, not just those contributed by the site.

The exposure assessment should be redone after consultation and agreement among the tri-parties on exposed populations and exposure activities. The parameters in the HSB RAM should be used. Both the incremental cancer risk posed by site activities and the total incremental cancer risk should be presented to provide risk managers with complete information.

- **Toxicity assessment.** The toxicity profiles in Section 4.1.3.3 do not cite references needed to support the statements made. References should be included for all values, such as biological half-lives.

Specific comments for the human health evaluation presented in Section 4.1 are not included in this review because the general problems require reassessment of the human health threats, thus limiting the usefulness of specific comments at this time.

The plan in general provides a comprehensive review of available data that affect ecological receptors associated with Columbia River habitats. While the plan considers most potential ecological exposure scenarios, certain ecological exposure routes warrant more attention.

The uncertainty analysis states that the potential for exposure of aquatic receptors to contaminants in groundwater plumes intersecting Columbia River sediments has been virtually ignored. The text indicates that currently no accepted procedures exist for evaluating environmental exposures to contaminated sediments. Given the possibility that benthic and bottom-feeding receptors may be exposed for longer periods of time to higher concentrations of contaminants carried in groundwater plumes than surface water receptors, this pathway should be discussed. For example, Dauble and Watson (1990) describe spawning areas for Chinook salmon (Oncorhynchus tshawytscha) and Fickeisen et al. (1980) list steelhead trout (Oncorhynchus mykiss) spawning grounds in areas of the Hanford Reach that could be subject to groundwater plume intersection. According to an NCRP study (1991), the early stages of fish egg development are the most sensitive to radiation exposure. Therefore, additional attention should be given to developing eggs of Chinook salmon and rainbow trout while in their redds.

The uncertainty analysis states that there are currently no accepted procedures for evaluating environmental exposures to contaminated sediments. However, Ecology (1991) lists a number of criteria and guidelines for exposure to chromium in sediments. These criteria and guidelines should be considered in a discussion of risk.

The environmental impact characterization uses environmental hazard quotients (EHQ), based on the lowest observed adverse effect level (LOAEL) concentrations or the no observed adverse effect level (NOAEL) concentrations, for radioactive

contaminants. These EHGs are then used to derive an environmental hazard index (EHI), which is the sum of radioactive and nonradioactive contaminant EHGs. The resulting EHI is used to argue that threats to environmental receptors posed by contaminants do not exist. Nonetheless, the use of LOAELs and NOAELs for radioactive compound risk evaluation in the aquatic environment warrants significantly more discussion. NCRP (1991) reports that several factors can significantly modulate the response of aquatic receptors to radiation exposure. Among them are water temperature, presence of competing stable elements, sensitivity varying with life stage, metabolic rate, and gut absorption factors for different species. The text should at least describe the conditions under which the LOAEL and NOAEL values were derived. It can then be determined whether these values are comparable, protective, and provide a sound basis for any subsequent conclusions.

The input parameters used for the river-mixing model appear to be reasonable.

The input parameters for the ground-water flux calculations also appear to be reasonable; generally even somewhat conservative (i.e., result in larger fluxes of contaminants).

The statement on page 76 that suggests extending the "Hanford Reach" to McNary Dam is an excellent idea. Much (most?) of the contaminated sediment from reactor operations is likely behind McNary Dam within the sediment pile in Lake Wallula.

The suggestion for creating a "Hanford Reach Aggregate Area" appears to be a good one. We need some way to coordinate the needed river-related investigation activities.

Prior to the aggregate area approach, we were strongly recommending that river transects be included in all the work plans. Although it is not explicitly stated within this report, it appears as if the transect work outlined in some of the earlier work plans has been abandoned. The transect work (if successful) will result in a measurement of total contaminant flux to the river. Although this measurement will have some of the same limitations as the river spring/seep measurements (i.e., the flux is dependent on the interaction of the river and aquifer and may vary significantly through time), it will represent a measured flux while all other planned approaches rely on estimates of flux. See comment on the need for transects (p. 80, Section 5.2.2.1, Activity 1A-2).

The lack of further river spring/seep measurements is acceptable if it is understood by DOE that they will therefore have to use measured ground-water contaminant concentrations for any risk assessment related to river springs/seeps.

A small caveat regarding use of maximum groundwater concentrations in this application; there is the potential for

the occurrence of contaminant concentrations that would exceed what we are likely to encounter in the groundwater during routine operable unit investigations. If there are significant contaminants in the vadose zone immediately above the water table, and if an unusually high river stage resulted in saturation of these materials, then a short-term (?) high concentration could be produced at river springs/seeps when the river stage declined. The potential for this phenomenon, or the likely magnitude and/or duration of it are presently unknown. Our investigations of the vadose zone in the operable units should increase our ability to estimate the possible impact of this phenomenon.

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In reviewing one of the referenced documents in the report (Robeck and others, 1954), I encountered an interesting item. Their work included analyses of the raw and finished waters at some of the downriver water treatment plants. They discovered that some radioactive materials were removed during treatment (e.g., coagulation and filtration at the Pasco treatment plant resulted in reduction of activity levels by 50 to 95%). They also go on to suggest that studies should be done to determine if there are resulting build ups of radioactive materials in the sludges, etc. associated with the treatment plants. I haven't encountered any Hanford studies that address this subject. This may be worth investigating.

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When the time arrives for DOWs to be created for the river sediment work, we will need to carefully consider how to best perform this work. It has been suggested (by Bob Peterson and others) that the results we obtain may well be influenced by the size fraction, mineralogy, etc. of the sediment sampled and analyzed. There has been some previous work on this subject; "Relations Among Radionuclide Content and Physical, Chemical, and Mineral Characteristics of Columbia River Sediments", J. L. Glenn and R. O. Van Atta, USGS Open-File Report, Portland, Oregon, 1971. This may be useful in designing the sediment-sampling activities.

The figures showing model-calculated contaminant concentrations along the right bank of the river are potentially misleading (see comment on pp. 43-49, figures 3-5 through 3-11). The model results should show a maximum concentration equal to the ground-water plume concentration for the area of plume entry into the river (this will actually be a point in the figures because the plume is represented as a vertical line in the model). In reality, there should be an area of plume entry into the river throughout which the contaminant concentration in the river equals the plume concentration.

SPECIFIC COMMENTS

1) Comment Page 2, Section 1.2, 2nd paragraph, 9th line
It is stated that only existing, publicly-available information was used. Is there other pertinent (non-public) information? If

so, this information should be made available. If not, perhaps this sentence should be rephrased.

2) Comment Page 5, Section 2.1.1, mid 1st paragraph

"It is the last free-flowing, non-tidal stretch of the Columbia River in the United States...Therefore the Hanford Reach has important ecological functions." This is not a cause/effect or logical conclusion statement. The Hanford Reach had important ecological functions before the rest of the river was impounded. Also impounding the rest of the river likely has diminished or even eliminated former ecological functions. (For example, the salmon run that currently spawns in the Hanford Reach probably was historically much larger than it is today.) Suggest changing the wording more along the lines that ecological functions dependant on free-flowing river is now limited to the Hanford Reach (within the U.S.).

3) Comment Page 5, Section 2.1.1, end of 1st paragraph

"The EIS...is due Spring, 1992". Recommend changing to summer. (My last phone conversation with F&WS indicated late July.)

4) Comment Page 5, Section 2.1.1, 1st paragraph

The text refers to the Hanford Reach as a spawning ground for several salmonid species. The text should provide a reference for this assertion, such as Dauble and Watson (1990) or Fickeisen et al. (1980).

5) Comment Page 5, Section 2.1.1, beginning of 2nd paragraph

"by a shrub-steppe habitat community". Suggest removing "community" as it is redundant. "Habitat" may be better if replaced with grassland (as per Daubenmire 1970)

6) Comment Figure 2.1, page 6

The figure should indicate river mile positions of the reactors within the 100 Area to facilitate locating salmonid spawning areas in relation to reactor sites.

7) Comment Page 7, Section 2.1.2, 1st paragraph

"the total population 80 km" change to "the total population within 80 km"

8) Comment Page 7, Section 2.1.2, end of 2nd paragraph

"About one-third of the crop acreage is irrigated," may be better if changed to "During the growing season, about one-third...".

9) Comment Page 7, Section 2.1.2, third paragraph

This paragraph about the Indian's claim to the land invites covering the whole gamut of claims to the site. Since who has what claims to the land, and what should be done with Hanford following cleanup and release by DOE is not the topic of this report, suggest removing this paragraph entirely.

10) Comment Page 8, Section 2.1.3, last paragraph

"Along the Hanford Reach, the river is 370-550-m...wide and 3-to-12-m...deep". This indicates that it is never wider, narrower, deeper, or shallower. Suggest qualifying the statement.

11) Comment Page 8, Section 2.1.3, last paragraph

Perhaps a concluding statement that the main channel bottom is stable would be informative. (This is important from the cleanup perspective to indicate that the river path during the active years of the single pass reactors is the same as today.)

12) Comment Page 8, Section 2.1.4, end of 1st paragraph

"Other wetland types...seasonal, impounded; and palustrine, emergent, persistent, seasonal, impounded." Suggest changing to "Other wetland types...seasonal, impounded, palustrine, emergent, and persistent." Also are there any submerged wetlands (you'd think so). Also any tidal wetlands (Priest rapids dam discharge driven rather than lunar/solar driven)?

13) Comment Page 9, Section 2.1.4, 2nd paragraph

The paragraph refers to macrophytes as having considerable value as food and shelter for juvenile fish. It should also be mentioned that macrophytes provide the same functions for waterfowl and invertebrates.

14) Comment Page 9, Section 2.1.4.1, end of 1st full paragraph

"watermilfoil...have considerable ecological value". Is this true? Maybe, but it sounds suspicious. Need a reference or data to support this statement.

15) Comment Page 9, Section 2.1.4.1, beginning of 2nd paragraph

"All major freshwater benthic macroinvertebrates are represented in the Columbia River (Fickeisen et al, 1980)." This statement must be taken out of context and is misleading. An exaggerated for example, the species richness in this cold oligotrophic river is obviously low relative to most tropical lakes and rivers. In a June 19 phone conversation with Steve Weiss, he remarked on the paucity of benthic invertebrates in the river. This is one of the reasons that the projected benthic sampling is geared to sediment only, rather than include benthic infauna too. Suggest not using Fickeisen's statement.

16) Comment Page 9, Section 2.1.4.1, last full paragraph

This paragraph is already covered in section 2.1.2 and therefore is redundant here. Suggest removing it entirely.

17) Comment Page 10, Section 2.1.4.2, beginning of 3rd paragraph

Suggest changing the first sentence "Tree species that characteristically border most streams and rivers are scarce." with "Typical riparian tree species are scarce along the Hanford reach."

18) Comment Page 10, Section 2.1.4.2, end of 3rd paragraph

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"the trees add to the habitat diversity of this semiarid region and may be important to many wildlife species." The trees obviously are important.

19) Comment Page 11, Section 2.2.1, first few paragraphs Groundwater is being spelled as "ground-water" and "ground water". One spelling should be chosen and promulgated throughout the document. We would suggest "groundwater", but most importantly, make a decision, and promulgate it.

20) Comment Page 11, Section 2.2.1, 3rd paragraph The text discusses the method for determining the "major" chemical and radiological contaminants in groundwater associated with the 100 Area. This method is not acceptable for risk assessment purposes. Screening for contaminants of concern should follow the method outlined in the HSB RAM (DOE 1991a).

21) Comment Page 13, Figure 2-3 It is indicated that 43 wells are monitored in the 100-N Area. Do none of these exceed the 20 mg/L nitrate concentration (lowest contour value)? The figure implies that all 43 wells have concentrations less than 20 mg/L. If this is not the case, then some contouring (or other indication) of values greater than 20 mg/L is warranted.

22) Comment Page 13, Figure 2-3 Do nitrate values greatly exceed 45 mg/L at any location? If so, then additional contour lines are needed (e.g.; 2x45, 3x45, etc.).

23) Comment Page 14, Figure 2.4 The legend provides information for 200,000 pCi/L and 2,000,000 pCi/L tritium concentrations, but the contours for 200,000 pCi/L and 2,000,000 pCi/L are not shown on the map. This discrepancy should be addressed.

24) Comment Page 14, Figure 2-4 The figure indicates that all values in the 100-K Area are <5,000 pCi/L. However, the Hanford Site Environmental Report for Calendar Year 1990 (PNL-7930, UC-602) includes a figure (p. 144) which shows one well in the 100-K Area which has had a tritium concentration consistently in the 900,000 to 1,000,000 range from 1981 through 1990, and one other well in the 5,000 to 100,000 range for the same period. If there are concentrations >5,000 in the K-Area, this should be reflected in the contours shown in the figure.

25) Comment Page 14, Figure 2-4 The figure indicates that all values in the 100-F Area are <5,000 pCi/L. However, the Hanford Site Environmental Report for Calendar Year 1990 (PNL-7930, UC-602) includes a figure (p. 143) which shows a 5,000 pCi/L contour in the 100-F Area for 1990. The error needs to be corrected.

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26) Comment Page 14, Figure 2-4

The value of the contour line northeast of the 100-D Area needs to be labeled.

27) Comment Page 15, Section 2.2.1, 1st paragraph

"if their concentrations exceeded the more stringent of concentrations promulgated...". Suggest changing to "if their concentrations exceeded the more stringent of standards promulgated..."

28) Comment Page 15, Section 2.2.1, end of 1st paragraph

"there is a potential for contaminants generated by past operations in the 100 Area to reach the Columbia River". This is not a potential, this is a reality.

29) Comment Page 15, Section 2.2.1, 2nd paragraph

The text refers to the conceptual study in Appendix B as the source for the identification of contaminants of potential concern. Although data on such contaminants are presented in Appendix B, an evaluation of the data and a discussion of the selection criteria are not provided. The selection criteria for potential contaminants of concern should be clearly described in the main text.

30) Comment Page 16, Figure 2-5

No indication is given of 300-Area plume(s).

31) Comment Page 17, Table 2.1

References for the values, source concentrations and flow rates, shown in this table are not provided as footnotes, but should be.

32) Comment Page 17, Table 2-1

No tritium plume is indicated for the 100-H Area. However, figure 2-4 shows a plume in (adjacent to?) the 100-H Area.

33) Comment Page 17, Table 2-1

A concentration of 50 mg/L is listed for the 100-BC-1 plume, but figure 2-3 shows only a 20 mg/L contour. If there are concentrations greater than 45 mg/L, then a 45 mg/L contour should be shown.

34) Comment Page 17, Table 2-1

A tritium plume is indicated for the 100-K Area, but none is shown on figure 2-4 (see above comment on figure 2-4 re. 100-K Area).

35) Comment Pages 15,17,18 and elsewhere.

The 100 Area operable unit work plans identify a much more encompassing list of contaminants of concern than addressed in this report. Since M-30-02 is an aggregate area effort, the union of these lists should be the starting point for the river impact study. The basis for non inclusion of any of these contaminants needs to be defended. Co-60 is an example of the disparity in the documents; it is included in the preliminary

list of contaminants of interest in 100 area work plans, it is so abundant in the 1301-N Liquid Waste Disposal Facility as to contribute to a skyshine risk in the 100-N area, is currently being found in 100-N area clams; and yet it is not included in the radiological contaminants list in section 2.2.1.2.

Additionally, the river impact study is intended to support a larger risk assessment effort. The risk assessment working group is using an incremental lifetime cancer risk of $1E-07$ and a hazard quotient of 0.1 in the identification of contaminants of potential concern. These thresholds should also be applied to 100 area contaminants in the river for inclusion in the impact assessment and planning for future use.

36) Comment Page 16, Figure 2-5.

I think that a groundwater elevation chart would be more meaningful than this drawing. The shape of the river is horribly distorted from reality and even from the shape used in the flow model. There is no obvious reason for the inclusion of some and the exclusion of other operable units, nor is this reasoning provided. The flow arrow for 200-E is larger than the others. This is not explained. If the reader guesses that this is due to a larger groundwater flow, then why isn't the 100-K area larger than the 100-BC area (as illustrated on the next page). The figure legend does not indicate that the groundwater plumes referred to are those defined in Appendix B. (This same point applies to table 2-1). Why is the 100-BC area shown way up by Vernita Bridge, where as 100-K is far away by 100-N? Granted the drawing is not meant to be to scale, but it is too skewed to have conceptual value. Suggest replacement with a simplified groundwater flow chart (water table elevation with streamlines).

37) Comment Page 19, Table 2.2, and page 20, Table 2-3

These tables present only one year (1990) of inventory data for radioactive and nonradioactive constituents in liquid effluents discharged to the Columbia River from the 100 Area and to ground disposal facilities in the 100 Area. The data presented in these tables may not indicate the magnitude of impacts from the total quantity of contaminants discharged since operation of the 100 Area reactors began. For example, the cumulative inventory of selected radionuclides disposed of in cribs and trenches in the 100-NR-1 operable unit itself is approximately 10,000 curies (accounting for decay to September 1985) (DOE 1991b). Hence, the cumulative multi-year inventory of the radioactive and nonradioactive constituents since operation of the 100 Area reactors began should be presented to evaluate the impact on the Hanford Reach from past waste disposal practices at the 100 Area.

38) Comment Page 20, Section 2.2.2.1, 1st paragraph, 5th line

The USGS river-monitoring data for 1990 that were not reported in the 1990 Hanford Site Environmental Report, are readily available (published in USGS annual Water Resources-Data Report, WA-90-1; Miles and others, 1991). Were the other "incomplete data" (i.e., not reported in the 1990 Environmental Report) also available?

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39) Comment Page 24, Table 2-4

The 1990 value for tritium at Richland (1.05 pCi/L) is apparently a misprint.

40) Comment Page 25, 1st bullet

Change "the levels of potential contaminants in river water" to
"the levels of contaminants in river water".

41) Comment Page 25, end of 1st full paragraph

"these data do not show any impact on overall river-water quality". Not true. The preceding six pages of data this report presents as a basis for this statement is all abiotic chemistry data. Therefore impact, as used in this section must be referring to water/sediment chemical residues, not biological diversity/health concepts. This statement, then conflicts with many others in the report: "Sediments of the Columbia River are known to contain low levels of radionuclides of Hanford origin" (page 26, last paragraph), "Contaminants attributable to Hanford Site operations are found throughout the Hanford Reach ecosystem." (page 30 last paragraph). Your data presentation shows Total Uranium higher downstream of Hanford in 14 of the past 15 years. One of the reports you cite, the "Hanford Site Environmental Report for 1990" showed elevated Sr-90 levels in fish bone in the 100-F area, clams showed elevated Co-60 and Sr-90 in the 100-N and 300 areas, etc. The point of this comment is that it is well recognized that contaminants have been released by Hanford to the river and this appears in the water, sediment, and biota, and the whole purpose of the M-30-00 milestone is to quantify the effect. All the "no impact" statements are unfounded. Suggest removing this and all similar statements.

42) Comment Page 26, Section 2.2.2.2, end of 3rd paragraph.

"Although contaminants added to the river remain in the water,...". This is not true. Contaminants traverse through and may deposit for extended periods in the biota and sediments.

43) Comment Page 27, Section 2.2.3, mid 1st full paragraph.

Explain how "derived background concentrations" is different than just "background concentrations".

44) Comment Page 27, Section 2.2.3, end of 1st full paragraph

"The presence of metals in the sediment are attributed to past and present mining activities..."(DOE/RL-92-12). The springs/seeps study did not have a sampling design sufficient to identify which of any upstream sources contributed what fraction of upstream loading. A statement regarding "mining activities" in that report could only be a conjecture, not supported by data. Therefore it should not be referenced.

45) Comment Page 29, Section 2.2.4, 3rd paragraph, 5th line

"...chemicals was..."should be "... chemicals were..."

46) Comment Page 30, Section 2.2.4, mid page

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"The levels of these metals in the heron rookery were less than levels reported at other Pacific Northwest locations (Fitsner et al, 1982)." This could be a useful reference if it can be stated that these other rookeries are sustaining or exporting (productivity assessment) and in relatively pristine areas. A favorable comparison of Hanford's rookery with healthy, productive, nearly pristine rookeries would be a strong statement. A favorable comparison with poorly-productive contaminated rookeries is a weak statement.

47) Comment Page 30, Section 2.2.4, last paragraph

"there are no impacts on the Hanford Reach that can be solely attributed to 100 Area operations." This statement gives the reader (and the public) the impression that sole allocation of source for any contamination needs to be assigned to a particular operation or area as part of the assessment or cleanup process. Suggest removing this statement.

48) Comment Page 32, Figure 3-1

A direct connection should be shown from groundwater to river sediments. Some groundwater discharges directly through the river sediments and into the river.

49) Comment Page 32, Figure 3.1

Several additional pathways should be included in the flowchart illustrating potential pathways for contaminant movement. These include:

- Groundwater to riparian flora via surface seeps and springs
- Riparian flora to terrestrial animals
- Groundwater to river sediments via subsurface flows
- River sediments to fish (redds)

50) Comment Page 33, Section 3.1.2, 1st paragraph

The text states that the surface water pathway is the primary pathway for exposure of ecosystem components. This statement does not reflect the considerable potential for sediment-related exposure. The text should be modified to address this possibility.

51) Comment Page 33, Section 3.1.3, 1st paragraph

The text implies that because of 1) the absence of a consensus methodology for contaminated sediment evaluation and 2) the absence of evidence of sediment-related impacts, river sediments will not be evaluated. While it is true that a consensus methodology does not yet exist, several methodologies are summarized in Ecology (1991) and can be used for a discussion of environmental risks. Furthermore, the absence of past or present ecological impacts on sediments does not prevent a discussion of potential sediment impacts resulting from groundwater contamination. NCRP (1991) and Dauble and Watson (1990) provide material for such a discussion in terms of spawning ground locations, preferred spawning habitat sediment characteristics,

and acute and chronic effects data on aquatic receptors exposed to radiation.

52) Comment Page 33, Section 3.1.2, 2nd paragraph

"Recent analyses of river-water quality do not show differences between sampling points that are upstream and downstream of the Site. Consequently, it is not likely that an environmental or health impact can be attributed to current conditions." Two points to make: 1) This reasoning misses the point that environmental and health impacts within the Hanford Reach itself is a primary focus of the river study. Impact within the Reach itself that is not evident downstream is not the same as no impact. 2) The first statement conflicts with other statements in this report (that identify increases downstream due to Hanford): (for example the second bullet on page 25, figure 2-8). Recommend removing these two statements.

53) Comment Page 33, Section 3.1.3, 1st paragraph

Yes, refinements of methodologies for sediment exposure evaluation are not as developed as for the primarily ingested fractions. This has hampered previous studies and thus has contributed to the "lack of evidence of past or present significant ecological impacts associated with contaminated sediments". This does not mean impacts haven't happened, merely that the tools to quantify them haven't been built and applied to this area. This should at least qualitatively be addressed. This recognition of lack of supporting data no doubt gives rise to the statement "Data collection activities needed to fill this data gap are discussed in Section 5.2." Therefore, sediment should be included in the potential exposure pathways in section 4.1.2.2.

54) Comment Page 34, Section 3.1.4, 2nd paragraph

"human ingestion of fish is judged to be the most significant biotic pathway." Judged by who? Need a reference. And this statement conflicts with the next paragraph "in 1990 the primary pathway of population exposure related to the Columbia River was consumption of drinking water". Resolve the conflict and then defend it with credible references.

55) Comment Page 34, Section 3.1.4, 4th paragraph

The paragraph refers to sensitive and critical habitats. The terms sensitive and critical habitats are not, but should be defined.

56) Comment Page 34, Section 3.1.4, last paragraph

"Contaminant exposures to...endangered or threatened species... not...a significant concern". This is a very important and significant statement that needs a strong support. The only support provided for this statement is that one of the food items for one of the threatened species is seemingly not heavily contaminated. This statement is neither referenced nor is supporting data provided. This statement, about eagles eating salmon presumes that eagles eat only salmon, do not breath

(thereby inhaling fugitive dust, vapors, etc), have impermeable skin, are immune to external radiation exposure (skyshine, perching on or near radiation zones), don't encounter the wet shorelines near seeps/springs, do not prune themselves (more fugitive dust intake)... Other endangered/threatened species are not discussed. Even if a credible description for eagles is provided, to extrapolate from them to the conclusion of "not...a significant concern" is unfounded. This section needs substantiation.

57) Comment Page 34, Section 3.2, 1st paragraph

Most contaminants flowing through the aquifer are retarded due to interaction with the aquifer matrix. To assume otherwise invites conclusions that some or lots of the contamination has been flushed with the groundwater when it may in fact still be mostly in the aquifer. By the same token, contaminants may (and in fact do) accumulate in river bottom sediment, and are immediately flushed away with the flowing river. A conservative and clearly more realistic assumption would be that there is considerable contamination bound to the aquifer matrix and after the current aquifer's water is discharged, the replacement water will scavenge contaminants from the matrix and in turn become contaminated.

58) Comment Page 36, Section 3.3.2.1, next to last paragraph,
last sentence

"...concentration..." should be "...concentration..."

59) Comment Page 39, Section 3.3.2.1, last paragraph

A transverse dispersion coefficient is used to account for variations in river flow velocity yet the second assumption at the top of page 36 is that river flow is steady-state. This disparity needs clarification.

60) Comment Page 39, Section 3.3.2.1, next to last paragraph,
last sentence

"...Table 2-2..." should be "...Table 2-1..."

61) Comment Page 42, Section 3.3.2.1, equation 2

An equation is given for the computation of the transverse dispersion coefficient, but no resulting value(s) is given. Was a single value calculated (based on an average slope)? What was the coefficient value(s) used? What was the slope value(s) used?

62) Comment Page 42, Section 3.3.2.1, next to last sentence

It is stated that the accuracy of equation 2 is plus or minus fifty percent. This is inaccurate and misleading. What is stated in Fischer and others (1979), is that the equation is "likely to be correct within an error bound of approximately fifty percent" for straight, rectangular channels.

63) Comment Page 42, Section 3.3.2.2, 2nd paragraph, 2nd sentence

It is stated that the line source is a conservative assumption. This is true in that an actual two-dimensional surface of

9 2 1 2 6 1 3 2 1 0 1

ground-water flux to the river is being represented as a line source. However, the model representation (vertical line) places the flux along the entire depth of the river, resulting in instantaneous vertical mixing, which may not be the case in the real world. This aspect is not conservative.

64) Comment Page 42, Section 3.3.2.2, 2nd paragraph, lines 7-8
It is stated that the source is represented as a line along the river bank (horizontal line). The model actually uses a vertical line to represent the source (see Section 3.3.2.1).

65) Comment Pages 43-49, Figures 3-5 through 3-11
These figures all indicate concentration "along the right bank". Along the bank at a point of contaminant discharge, the concentration should equal the plume concentration (see Table 2-1). However, in the 100-N Area, for example, the Sr-90 plume concentration equals 10,000 pCi/L, but figure 3-5 shows a maximum concentration along the right bank of 100-200 pCi/L.

66) Comment Page 53, Section 4.1.1.1, last paragraph
Why are estimated water concentrations for the Richland water intake used when actual data is available? (In table 4-1 too.) Proposed MCL values are used instead of NCP values. In keeping with the conservative approach in the risk assessment, the cancer risk level used for the proposed MCLs should be indicated, and shown to be less than the 10^{-4} used in the NCP.

67) Comment Page 55, Section 4.1.2.1 2nd paragraph
Recreational users are evaluated for adults only. This is not appropriate. Young children are often present among boaters up-river from Richland. If a boat pulls ashore, probably the first ones out are the children who run and play along the river bank. They are the ones most likely to play in a spring or wet bank. Adults are not nearly as likely to sit and play and accidentally or intentionally drink some of the seep water as children are. Therefore children should be evaluated in the exposure scenario as well as the adults.

68) Comment Page 55, Section 4.1.2.1, 2nd paragraph, 4th sentence
It is stated that the City of Richland uses river water to artificially recharge the unconfined aquifer. This is true most of the time. However during equipment maintenance aquifer recharge with river water is suspended. The details of this should be included in the report.

69) Comment Page 55, Section 4.1.2.2
Why are the exposure pathways for residential and recreational users different? Understandably durations and relative importances of different facets would vary, but the components of the pathways should be the same.

70) Comment Page 55, Section 4.1.2.2
A bullet should be added to include ingestion of water fowl.

71) Comment Page 63, Section 4.1.3.3, tritium subheading
Tritium does pose an internal hazard that needs to be mentioned.

72) Comment Page 64, Section 4.1.3.3, 2nd paragraph under
"Nitrate", 1st line
Should "...or NO3..." be "...of NO3..."?

73) Comment Page 67, Section 4.1.5, 1st full paragraph
"some of the more popular fish caught" may be better stated "some
of the fish more commonly caught". This carries the idea of mass
intake for risk assessment calculations rather than popularity.

74) Comment Page 68, Section 4.1.6, 1st paragraph
"contaminants in the Hanford Reach possibly resulting from
activities at the 100 Area". Remove the word possibly. Again,
it is well known that the 100 Area has released these
contaminants to the Hanford Reach.

75) Comment Page 70, Table 4-6
The criterion listed for Cr is for Cr+6 and this should be noted.
Also, since this report is assuming all Cr is hexavalent, this
should be specifically stated for clarification for the reader
who may be concerned that the more toxic form is being ignored.

76) Comment Page 70, Table 4-6
The nitrate freshwater quality criteria of 10 ppm should be used
because it is a relevant criteria and is more stringent than the
400 ppm listed.

77) Comment Page 70, last sentence
Question for discussion. It is appropriate to add the EHqs for
non rad with the EHqs for rad samples?

78) Comment Page 71, table 4-7
Table 4-7 is footnoted to represent concentrations downstream of
the 100 Area, yet the paragraph below states that this table is
for in the Hanford Reach. This discrepancy needs to be
corrected. Additionally, most biota do not experience an average
Hanford Reach exposure. They live in their own micro
environment, and as a result their risk is better evaluated with
location specific data. A table with the information categories
of table 4-7 should be generated that includes a springs/seeps
bank and near-shore river analysis for each of the major 100
areas plus the Hanford town site.

ie:

Priest Rapids Dam...

-----Near-shore river-----		
Contaminant of Concern	Ambient Water Column Concentration	EHQ

100-BC

-----Wet bank (Spring/seeps impact zone)-----		
Contaminant of Concern	Ambient Water Column Concentration	EHQ

-----Near-shore river-----		
Contaminant of Concern	Ambient Water Column Concentration	EHQ

100-K...

Location specific EHQs summed to a EHI as shown in figure 4-1 is useful, but contaminant specific information is important for remediation guidance purposes.

79) Comment Page 71, Section 4.2.2, fourth paragraph

The text indicates that two peak EHIs do not adversely impact environmental receptors because it is unlikely that receptors are confined to such limited areas. This statement should be revised since the groundwater impact zones have not been delineated and uncertainty regarding receptor behavior has not been discussed.

80) Comment Page 71, Section 4.2.2, last sentence

"The fact that this scenario has a maximum EHI of 1.2 further indicates that the threat to environmental receptors does not exist." This statement conflicts with the last sentence on the previous page, ie: "an EHI in excess of unity is interpreted to signify the potential for adverse toxicological effects". Therefore by definition of EHI and the data provided in the previous paragraph, the statement on page 71 should be reworded that "this analysis indicates the potential for adverse toxicological effects in the 100-N area".

81) Comment Page 72, figure 4-1

A) The figure title "Environmental Hazard Index" needs clarification, such as "EHI River Profile Within the Hanford Reach".

B) The definition of EHI in the legend should be changed from "average" to "location specific"

C) The figure caption should indicate that this is model output rather than actual data. If it is actual data, the graph should be linearly interpolated between data points. The spikes of higher value are graphed as if they have no up/down stream dimension, yet this is not supported with data. The data is for discrete points along the reach, not continuous transect data.

D) The vertical grid should be toned down or removed so as to prevent obscuring the data, especially the peaks.

82) Comment Page 73, Section 4.2.3, 2nd paragraph

It is unclear why only certain major sources of uncertainty are discussed. All major source of uncertainty as discussed in EPA guidelines (1989) should be addressed in this document.

83) Comment Page 73, Section 4.2.3, last paragraph

"There are currently no accepted procedures for evaluating environmental exposures to contaminated sediments." Several references to the best available references would be beneficial to support this statement.

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84) Comment Page 73, Section 4.2.3, last half of page
This report states that there are two assumptions that are non-conservative. It is important to identify all the non-conservative assumptions to help avoid making the mistake of underestimating risk. Several other assumptions are: A) Adult only direct exposure to the springs/seeps and sediment. (See comment page 55, section 4.1.2.1, 2nd paragraph); B) Additive EHQs to get an EHI. There may be synergistic effects, or even a potentiation effect from minor constituents or other factors.

85) Comment Page 74, Section 4.2.3, end of 1st paragraph.
Change "either synergistic, or antagonistic effects" to
"either synergistic, potentiation, or antagonistic effects".

86) Comment Page 75, Section 5.1, 2nd paragraph
This paragraph is not factual and not needed. This material is already in chapter 2.

87) Comment Page 75, Section 5.1, 3rd paragraph
Need a resolution of tense between "were detected...during reactor operation" "but the Hanford Reach retains". Since this report targets the current condition, suggest using the present tense.

88) Comment Page 75, Section 5.1, 3rd paragraph
"the Hanford Reach retains many of its functional qualities...[third bullet]...most contaminants...little significant difference between sampling points that are upstream and downstream". Again this interpolates between upstream and downstream locations to characterize the Reach. This is prone to error, and especially inappropriate when there is data within the Reach itself that shows higher contamination levels.

89) Comment Page 75, Section 5.1, 4th paragraph
"Such observations...indicate the absence of any significant adverse impact". The presence of a function does not indicate its capacity and therefore does not support this statement.

90) Comment Page 75, Section 5.1, last paragraph
"under current contaminant exposure conditions". Topic for discussion: current use vs future use.

91) Comment Page 75, Section 5.1, last paragraph
"predicted adverse impacts...are limited to localized zones" apparently conflicts with the last paragraph on page 71 discussing location specific EHIs with the statement "it is unlikely that such a condition represents an adverse impact to environmental receptors". This conflict need to be resolved.

92) Comment Page 76, Section 5.1, top bullets
Only two items are listed under current contaminants of concern and associated groundwater plumes: Sr-90 and Cr. What about tritium in the K area, or Co-60 or all the other contaminants identified in the operable unit work plans that this milestone is

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intended to support? Contaminants of potential concern used in the operable unit work plans should be the basis for the contaminants of potential concern in this document.

93) Comment Page 76, Section 5.2, 2nd paragraph
Change "assessment of baseline risks, associated with" to
"assessment of baseline risks associated with".

94) Comment Page 77, Section 5.2.1.1 2nd paragraph
"Available data pertaining to Columbia River" should be changed
to "Selected data...".

95) Comment Page 78, Section 5.2.1.1, 1st paragraph
Change "pertaining to first are" to "pertaining to the first are"

96) Comment Page 80, Section 5.2.2.1.1, mid page
"The only significant remaining source of 100-Area-related
contaminant input to the Hanford Reach is ground-water
discharge." Currently operating outfalls, and wind-driven
transport of surface contamination are sources not discussed and
dismissed as "insignificant" relative to the groundwater
discharge. A brief discussion, supported by references is needed
to make this statement.

97) Deficiency Page 80, Section 5.2.2.1.1, activity 1A-2
The presently planned groundwater investigations for the operable
units are not sufficient to adequately characterize contaminant
fluxes. There are two components of contaminant flux that need
to be identified: concentration of the contaminant and
groundwater flux to the river. The planned work in the operable
units should lead to good definition of the extents and
concentrations of contaminant plumes. However, based on planned
operable unit work, fluxes will be calculated values based on
estimated distributions of estimated hydraulic properties. A
series of transects would allow the fluxes to be "measured"
instead of estimated. This would allow for flux to be arrived at
from two separate methods and would result in much greater
acceptance by the public and the scientific community.

Recommendation

A series of river transects should be conducted to obtain a
measurement of contaminant flux to the river. These transects
were included in earlier work plans (e.g., 100-BC-5 Draft A, and
100-HR-3 Draft B) and should now be included as 100 Aggregate
Area work items.

98) Comment Page 80, Section 5.2.2.1.1, mid page
"remedial investigation/feasibility study" should be abbreviated
RI/FS to match the usage of FI/CMS. Also it should be RFI/CMS.

99) Comment Page 80, Section 5.2.2.1.1, 3rd paragraph
"Contaminants of potential concern will be identified" in
addition to HSBAM, include the operable unit work plans.

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100) Comment Page 82, Activity 1A-4, beginning of 1st paragraph
Change "is a 100 Area contaminants" to
"is a 100 Area contaminant".

101) Comment Page 85, Activity 2-2, 4th line
Change "amont" to "among"

102) Comment Page 85, Activity 2-2, last sentence of 1st
paragraph
"extensive" may be better replaced with something more along the
line of significantly risk inducing. Extensive can be
interpreted in a spacial or a concentration perspective and not
lead to the desired interpretation. For example, modeling of a
broad plume of very low contamination may not be justifiable.

103) Comment Page 87, Activity 4-1, 1st paragraph
Because Uranium has such a low solubility, only flow-through
bioassay data should have been seriously considered. If the
bioassays considered were well run with rapid flow-through, than
the argument of little or no exposure to the test organisms is
not appropriate. (This really is just a comment, not requiring a
specific response.)

104) Comment Page 88, Section 5.2.3
"except sediment sampling; the DOW for that project will be
submitted in June 92". EPA hasn't seen this DOW yet (July 6).
Suggest changing the date.

105) Comment Page 89, Table 5-1
Regarding the items without a DOW date. Will DOWs be written for
these tasks and will the regulators have a change to provide
input and review them?

106) Comment Page 89, Table 5-1, activity 10
"...Aras..." should be "...Areas..."

107) Comment Page B-1, Section B.1.1, 2nd paragraph
The stratigraphy of the Ringold Formation is presented in the
traditional four units (Basal, Lower, Middle, and Upper). Recent
stratigraphic study of the Ringold Formation has resulted in
subdividing the formation based on sediment facies associations.
A recent WHC document (Delaney and others, 1991), established a
"standardized" approach for defining the Ringold. It is
desirable that we use a single approach in defining/describing
the geology for CERCLA studies at Hanford.

108) Comment Page B-5, Section B.2.1, 1st paragraph, lines 1-2
"The thickness of unconsolidated deposits". Is this meant to
refer to just the Hanford formation or the often semi-
consolidated Ringold formation as well (suprabasalt).

109) Comment Page B-6, Table B-1
What does the 100-year "half life" for nitrate refer to?

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110) Comment Page B-8, Section B.2.1, last sentence in "Hydraulic Conductivity" paragraph

Based on the similarity of conductivity values between the 100-H and 100-N Areas, it was decided to use a common value for all 100 Areas. However, as stated on page B-5, the unconfined aquifer in the 100-BC Area is in a different unit (Middle Ringold vs. Pasco Gravel) than the other 100 Areas, and therefore will have different hydraulic properties. Since the Middle Ringold generally has a significantly smaller hydraulic conductivity than the Pasco Gravels, the use of a Hanford conductivity for analysis of the 100-BC plumes will probably overestimate the ground-water flux to the river.

111) Comment Page B-8, Section B.2.1, "Capture-Zone Analysis" paragraph

The terminology/concepts of "capture-zone" and "required ground-water extraction" inappropriately alludes to remediation approaches. All that is done in this section is a simple Darcy calculation of ground-water flux. The terminology used implies a ground-water treatment scenario that has not been discussed. More appropriate terminology should be used.

112) Comment Page B-9, Figure B-5

In the "Note", it is stated that "Some wells are completed below the water table". Presumably all wells that have water levels are completed below the water table. Is the intent to say that some wells are completed in units other than the unconfined aquifer? If so, their inclusion violates the first statement in the "Note" and the data from these wells should be removed from the figure.

113) Comment Page B-11, Figure B-6

Well B3-2 is used to help define a plume. B3-2 is a deep well completed in deeper units (not the water-table aquifer). This well should not be used to define the horizontal extent of a water-table plume.

114) Comment Page B-12, Section B.2.2, 1st paragraph

The background concentration for Ru-106 should be listed, since it is being referred to, and provide a reference.

115) Comment Page B-12, Section B.2.2, 100 K area last paragraph
The percentages add up to 105%. Should be corrected.

116) Comment Page B-18, Section B.2.2, 1st paragraph, last sentence

A pumping rate is indicated for "design of the treatment system". The only thing being done in this section is a calculation of ground-water flux, not a design for remedial action. See comment on Section B.2.1, p. B-8, "Capture-Zone Analysis" paragraph. It is premature in this document to be designing the treatment system. The sentence should be reworded.

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